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Two new species and several new records of the millipede genus *Epanerchodus* Attems, 1901 from China (Diplopoda: Polydesmida: Polydesmidae)

Два новых вида и несколько новых находок двупарноногих многоножек рода *Epanerchodus* Attems, 1901 из Китая (Diplopoda: Polydesmida: Polydesmidae)

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KEY WORDS: millipedes, taxonomy, iconography, new species, mainland China.

КЛЮЧЕВЫЕ СЛОВА: двупарноногие многоножки, таксономия, иконография, новый вид, материковый Китай.

ABSTRACT. Two new species of *Epanerchodus* are described from southwestern China: *E. liuae* sp.n. from Yunnan, and *E. wolongensis* sp.n. from Sichuan. New records of *E. potanini* Golovatch, 1991 and *E. martensi* Golovatch, 2014 are also presented.

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РЕЗЮМЕ. Описаны два новых вида рода *Epanerchodus* из Юго-Западного Китая: *E. liuae* sp.n. из Юннани и *E. wolongensis* sp.n. из Сычуаня. Представлены новые находки видов *E. potanini* Golovatch, 1991 и *E. martensi* Golovatch, 2014.

Introduction

The millipede fauna of continental China is very rich and diverse, presently encompassing 340+ species from 71 genera, 26 families and 11 orders [Golovatch, Liu, 2020]. *Epanerchodus* Attems, 1901 is one the most species-rich genera of the family Polydesmidae, and the largest in Asia, ranging from Central Asia in the west, through the Himalayas, to the Russian Far East, Korea, Japan and Taiwan in the east. At the moment, this eastern Palaearctic diplopod genus contains 120 accepted species, both epigean and cavernicolous, including 27 species, mostly keyed and mapped, in mainland China alone [Liu, Golovatch, 2018; Liu, Huo, 2020].

The present paper puts on record another small collection of *Epanerchodus* from China. This material comprises two new species and a number of new records, all epigean, of two already known congeners.

Material and methods

The samples underlying this contribution were either donated to me for treatment by Igor Belousov, Ilya Kabak and Genrikh Davidian (all St. Peterburg, Russia), housed in the Zoological Museum of the State University of Moscow (ZMUM), Russia, or handed to me on loan by Jochen Martens (Mainz, Germany) and Peter Jäger (Senckenberg Museum, Frankfurt am Main (SMF), Germany), to be deposited in the SMF.

The pictures were taken with a Canon EOS 5D digital camera and stacked using Zerene Stacker software. Final image processing was performed with Adobe Photoshop CC. The line drawings were made by the author.

Taxonomy

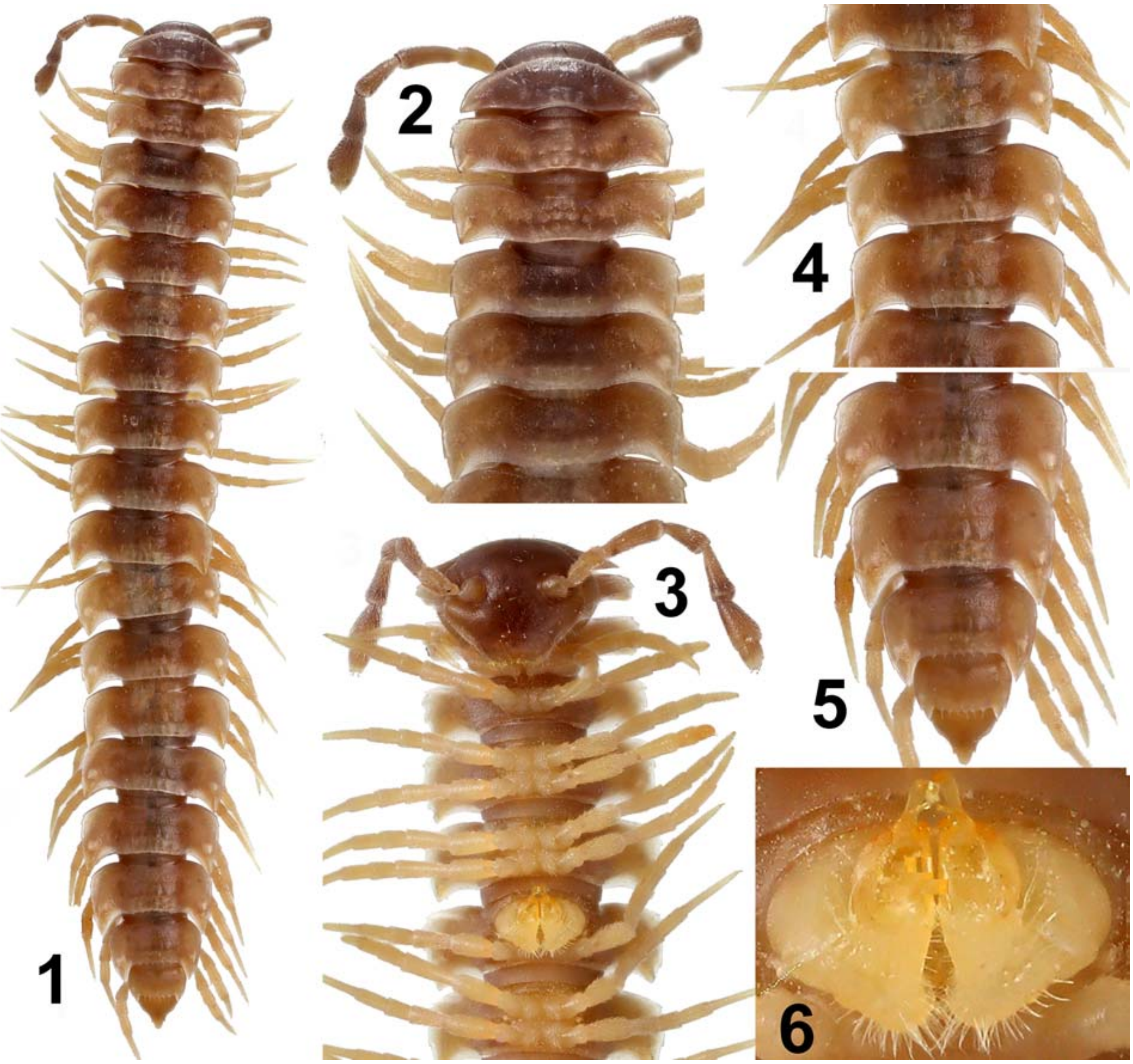
Epanerchodus luiae **sp.n.**
Figs 1–12.

HOLOTYPE ♂ (ZMUM), China, Yunnan Prov., SSW of Lanping, 3 lm NW of Qingmingchang, N 26º12′20″, E 99º16′01″, 2480 m a.s.l., 28.V.2018, I. Belousov & I. Kabak leg.

NAME. Honours Mrs Dr. Liu Weixin, a prominent specialist in millipede taxonomy in China.

DIAGNOSIS. Differs from congeners by the rather large size (width >4.0 mm), coupled with the head being narrower than the collum, the absence of sphaerotrichomes, lateral bulges on ♂ prefemora, and an exomere, and the shapes of the endomere (**en**) and its basal processes **p1** and **p2**. See also Remarks below.

DESCRIPTION. Length ca 25 mm, width of midbody pro- and metazonae 2.0 and 4.2 mm, respectively (♂). Colouration in alcohol rather uniformly brown with lighter

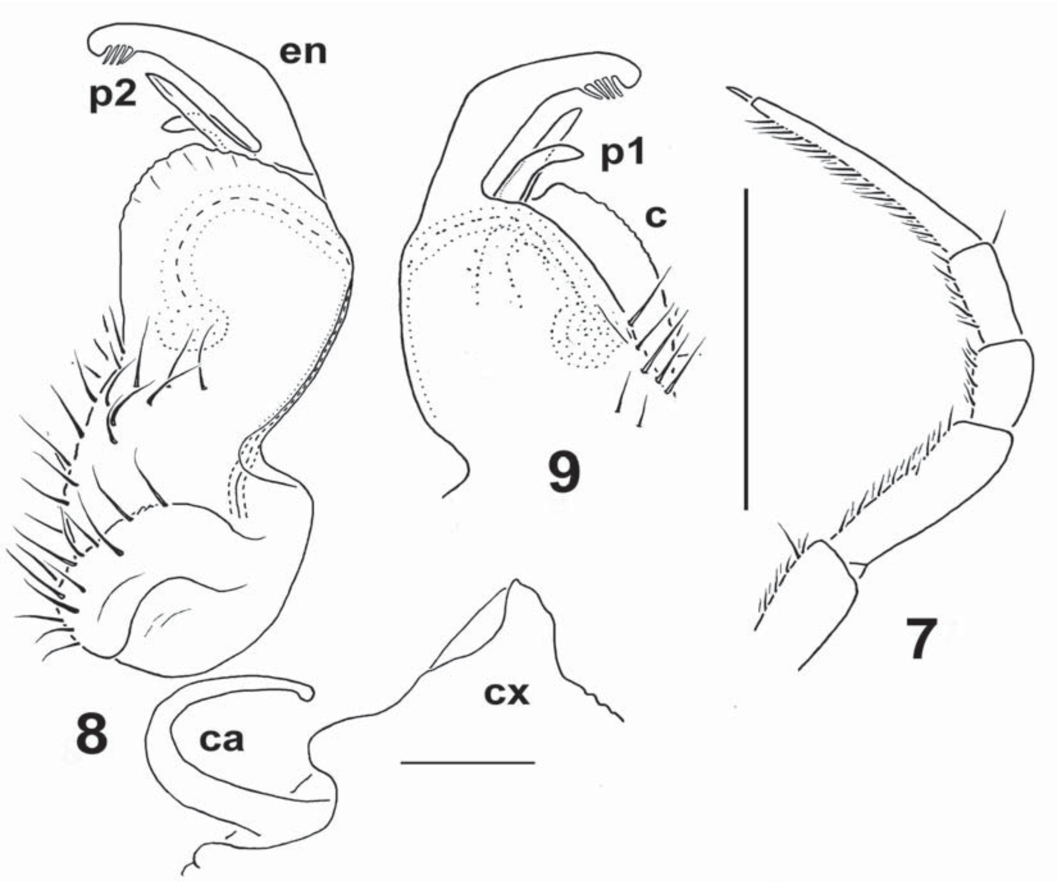


Figs 1–6. *Epanerchodus luiae* sp.n., holotype. 1 — habitus, dorsal view; 2, 3 — anterior part of body, dorsal and ventral views, respectively; 4 — midbody segments, dorsal view; 5 — posterior part of body, dorsal view; 6 — gonopods *in situ*, ventral view. Pictures by K.V. Makarov, taken not to scale.

Рис. 1–6. *Epanerchodus luiae* sp.n., голотип. 1 — общий вид, сверху; 2, 3 — передняя часть тела, соответственно сверху и снизу; 4 — среднетуловищные сегменты, сверху; 5 — задняя часть тела, сверху; 6 — гоноподы на месте, снизу. Фотографии К.В. Макарова, снято без масштаба.

brown paraterga and legs (Figs 1–5). Body with 20 segments. Tegument moderately shining, texture very delicately shagreened. Head pilose nearly throughout, with squarish genae. Antennae long and only slightly clavate due to highest antennomere 6 (height measured from the lower to the higher edge) (Figs 1–3), either reaching past segment 3 dorsally (♂); antennomere 3 the longest, ca 1.3x longer than subequal antennomeres 4–6; 5th and 6th each with a small, compact, distodorsal group of bacilliform sensilla; antennomere 7 with a minute dorsoparabasal cone and a distodorsal group of microscopic sensilla.

In width, head < collum < segment 3=4 < 2 < 5=15, thereafter body gradually tapering towards telson (Fig. 1). Paraterga strongly developed, set high (at about upper ¼ of midbody height), starting with collum, dorsum very faintly convex; paraterga mostly weakly upturned above dorsum. Caudolateral corner of paraterga spiniform, postcollum ones extending increasingly past rear tergal margin, especially clearly so in segments 16–18. All poreless segments with three, all pore-bearing ones with four, minute incisions at lateral margin. Front margins of metaterga narrowly bordered and forming distinct shoulders. Pore formula normal, ozopores evident, dorsal, located in front of posteriormost marginal indentation. Metatergal sculpture typical, poorly-developed, obliterate, with three transverse rows of typical (= polydesmid), setigerous, polygonal bosses (Figs 1, 2, 4, 8). Tergal setae very short, slightly longer only on collum, simple, often obliterate. Stricture between pro- and metazo-



Figs 7–9. *Epanerchodus luiae* sp.n., holotype. 7 — leg 9, lateral view; 8, 9 — left gonopod, mesal and lateral views, respectively. Scale bars: 0.5 (7) and 0.1 mm (8, 9). Designations explained in text.

Рис. 7–9. *Epanerchodus luiae* sp.n., holotype. 7 — нога 9, сбоку; 8, 9 — левый гонопод, соответственно изнутри и сбоку. Масштаб: 0,5 (7) и 0,1 мм (8, 9). Объяснения обозначений в тексте.



Figs 10–12. *Epanerchodus luiae* sp.n., holotype, right gonopod, ventromesal, mesal and ventrolateral views, respectively. Pictures by K.V. Makarov, taken not to scale.

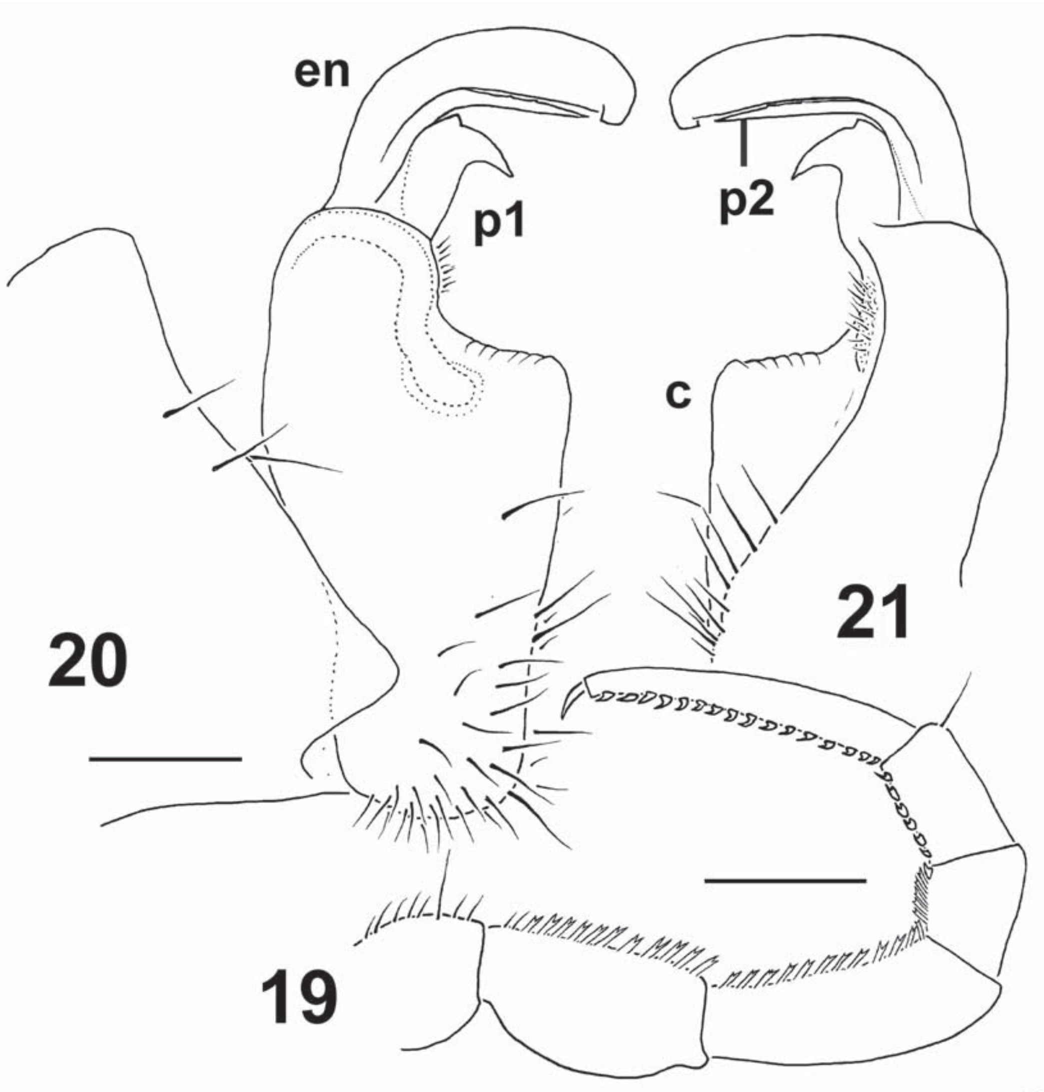
Рис. 10–12. *Epanerchodus luiae* sp.n., голотип, правый гонопод, соответственно одновременно изнутри и снизу, изнутри и одновременно сбоку и снизу. Фотографии К.В. Макарова, снято без масштаба.

na wide, shallow and nearly smooth. Limbus very thin, microdenticulate. Pleurosternal carinae absent. Epiproct rather short, conical, pre-apical lateral papillae evident (Fig. 5). Hypoproct semi-circular; caudal, paramedian, setigerous papillae small and well-separated. Sterna without modifications, densely setose. Legs (♂) generally rather long and slender, apparently slightly incrassate (Figs 1–5, 7), ca 1.7–1.8 times as long as midbody height, densely setose, almost



Figs 13–18. *Epanerchodus wolongensis* sp.n., ♂ paratype. 13 — habitus, dorsal view; 14, 15 — anterior part of body, dorsal and ventral views, respectively; 16 — midbody segments, dorsal view; 17 — posterior part of body, dorsal view; 18 — gonopods *in situ*, ventral view. Pictures by K.V. Makarov, taken not to scale.

Рис. 13–18. *Epanerchodus wolongensis* sp.n., паратип ♂. 13 — общий вид, сверху; 14, 15 — передняя часть тела, соответственно сверху и снизу; 16 — среднетуловищные сегменты, сверху; 17 — задняя часть тела, сверху; 18 — гоноподы на месте, снизу. Фотографии К.В. Макарова, снято без масштаба.



Figs 19–21. *Epanerchodus wolongensis* sp.n., ♂ paratype. 19 — leg 9, lateral view; 20, 21 — right gonopod, lateral and mesal views, respectively. Scale bars: 1.0 (19) and 0.2 mm (20, 21). Designations explained in text.

Рис. 19–21. *Epanerchodus wolongensis* sp.n., паратип ♂. 19 — нога 9, сбоку; 20, 21 — правый гонопод, соответственно сбоку и изнутри. Масштаб: 1,0 (19) и 0,2 мм (20, 21). Объяснения обозначений в тексте.

all setae simple, very poorly branching setae with minute, distal, side branchlets being observed only on slender prefemora, the latter devoid of lateral bulges (Fig. 7).

Gonopods (Figs 3, 6, 8–12) with large, subquadrate coxae (**cx**) strongly fused medially at base and carrying a few long setae ventrally; a long, simple and unciform cannula (**ca**) as usual. Telopodite elongated, stout, subfalcate only distally, prefemorite (= densely setose part) about half as long as entire telopodite; seminal groove running mesally over most of its extent, only distally moving frontally to recurve first laterad and then a little basad at base of a somewhat shorter, more complex endomere (**en**); exomere absent; clivus (**c**) a large, lateral and irregularly rounded lobe; a round accessory seminal chamber and a hairy pulvillus hidden inside a cavity between **c** and mesal wall of telopodite; **en** strong, regularly curved, slightly thickened in midway part and rounded apically, with a group of four tiny filaments below apex; a rather small, curved (**p1**) and a longer, straight, spiniform process (**p2**) at base of **en**.

REMARKS. Using the latest available keys to *Epanerchodus* species of mainland China [Golovatch, 2014a; Liu, Golovatch, 2018], as well as the later described congeners [Liu, Huo, 2020], *E. liuae* sp.n. invariably keys out to dead-end couplets. The closest congeners, both morphologically and geographically, seem to be *E. yunnanensis* Golovatch, 2014, *E. fuscus* Golovatch, 2015, and *E. typicus* Golovatch, 2014, incidentally all three from Yunnan [Golovatch, 2014a, b, 2015]. They all share, among many other characters, the head being distinctly narrower than the collum, combined with a poorly developed tergal sculpture; a brown general colouration; ♂ prefemora non-bulged laterally; a stout gonopodal telopodite lacking an exomere; a relatively short, simple and strong endomere (**en**) supplied with two processes at the base (**p1** and **p2**).

However, *E. liuae* sp.n. differs from *E. yunnanensis*, the latter species from Dali County, in being somewhat larger (ca 25 mm long and 4.2 mm wide, *vs.* 21–23 mm long and 3.2–3.5 mm wide), ♂ legs devoid of sphaerotrichomes (*vs.*



Figs 22–25. *Epanerchodus potanini* Golovatch, 1991, ♂ from Qinyugou, Gansu. 22 — habitus, lateral view; 23 — anterior part of body, ventral view; 24 — midbody segments, dorsal view; 25 — posterior part of body, dorsal view. Pictures by K.V. Makarov, taken not to scale.

Рис. 22–25. *Epanerchodus potanini* Golovatch, 1991, ♂ из Qinyugou (Ганьсу). 22 — общий вид, сбоку; 23 — передняя часть тела, снизу; 24 — среднетуловищные сегменты, сверху; 25 — задняя часть тела, сверху. Фотографии К.В. Макарова, снято без масштаба.

present on ♂ postfemora, tibiae and tarsi in *E. yunnanensis*), and the gonopods showing a curved and rounded process **p1**, and a thicker and apically rounded endomere (**en**) (*vs.* a straight and truncate **p1** and a more slender and apically trifid **en** in *E. yunnanensis*).

The type localities of both *E. liuae* sp.n. and *E. fuscus* lie within Lanping County, quite close to one another. Yet *E. liuae* sp.n. seems to differs from *E. fuscus* even more strongly: the colouration in *E. liuae* sp.n. is generally lighter brown (*vs.* very dark brown in *E. fuscus*), the size is larger (25 mm long and 4.2 mm wide in *E. liuae* sp.n., *vs.* 17 mm long and 4.0 mm wide in *E. fuscus*), ♂ legs are devoid of sphaerotrichomes (*vs.* in addition to modified bi- or trifid setae on ♂ prefemora and femora, present on ♂ postfemora, tibiae and tarsi in *E. fuscus*), and the gonopods showing a curved and rounded process **p1**, and a thicker and apically rounded endomere (**en**) (*vs.* a short, strong and lobe-shaped **p1**, and a shorter, only slightly curved and apically subtruncate **en** in *E. fuscus*).

Epanerchodus liuae sp.n. differs from *E. typicus*, the latter species from Shangrila County, in being somewhat larger (25 mm long and 4.2 mm wide in *E. liuae* sp.n., *vs.* 19 mm long and 3.8 mm wide in *E. typicus*), lighter brown (*vs.* dark brown in *E. typicus*), ♂ legs are devoid of sphaerotri-



Figs 26–29. *Epanerchodus potanini* Golovatch, 1991, ♂ from near Kekecun, Sichuan. 26 — habitus, lateral view; 27 — anterior part of body, dorsal view; 28 — midbody segments, dorsal view; 29 — posterior part of body, dorsal view. Pictures by K.V. Makarov, taken not to scale.

Рис. 26–29. *Epanerchodus potanini* Golovatch, 1991, ♂ из окрестностей Kekecun (Сычуань). 26 — общий вид, сбоку; 27 — передняя часть тела, сверху; 28 — среднетуловищные сегменты, сверху; 29 — задняя часть тела, сверху. Фотографии К.В. Макарова, снято без масштаба.

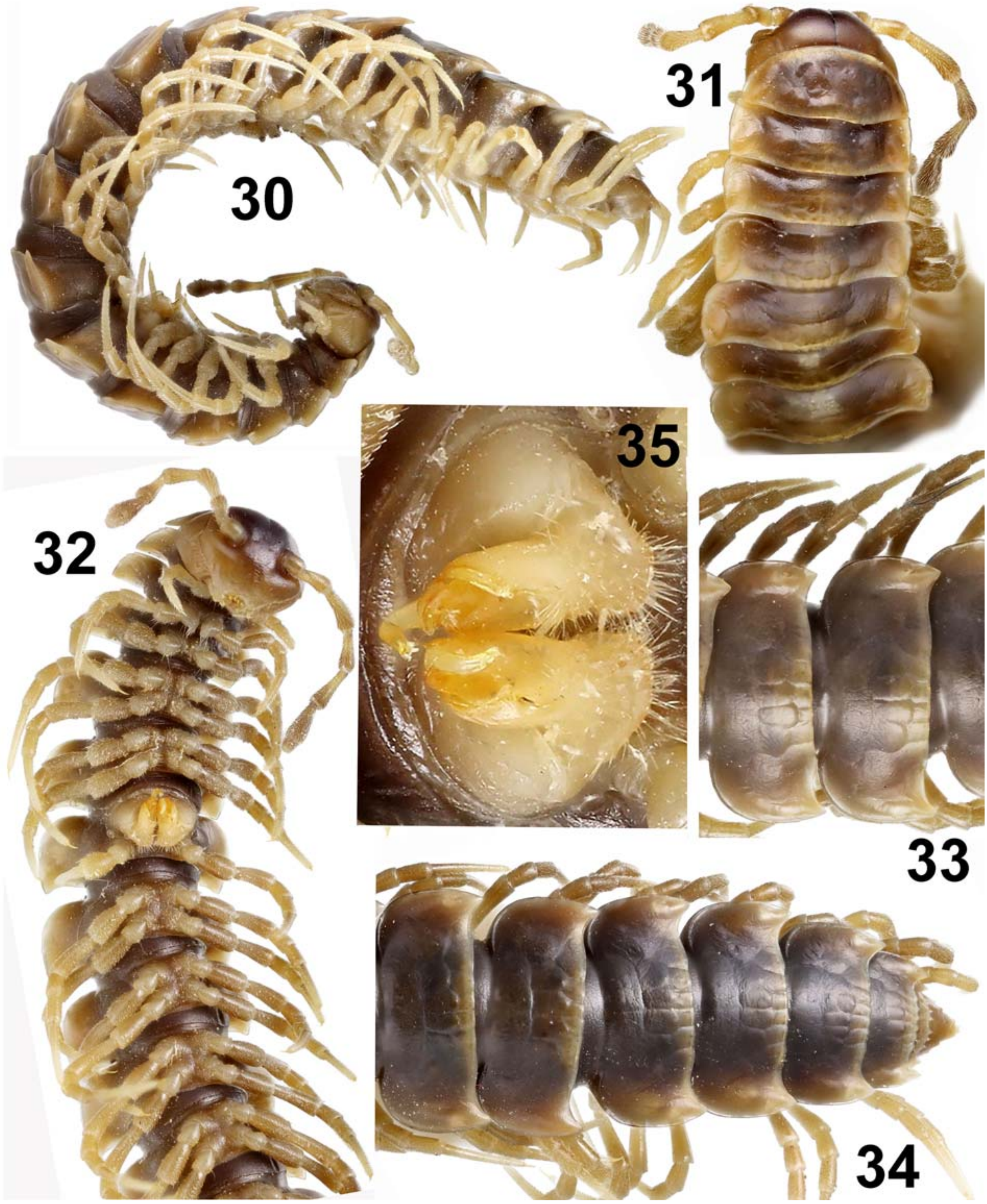
chomes (*vs.* in addition to clearly modified bi- or trifid setae on ♂ prefemora and femora, present on ♂ postfemora, tibiae and tarsi in *E. typicus*), and the gonopods showing a curved and bifid process **p1**, and a thicker and apically rounded endomere (**en**) with subapical filaments (*vs.* a short, strong and lobe-shaped **p1**, and an apically subacuminate and subunciform **en** devoid of subapical filaments in *E. typicus*).

Epanerchodus wolongensis **sp.n.**
Figs 13–21.

HOLOTYPE ♂ (SMF), China, Sichuan Prov., Wolong Town, N 31º01′, E 103º10′, 1900 m a.s.l., 28.IV.2012, J. Martens leg.

PARATYPES: 1 ♂, 2 ♀♀, 2 fragments (SMF), 1 ♂ (ZMUM), same data, together with holotype.

NAME. To emphasize Wolong, the type locality; adjective.



Figs 30–35. *Epanerchodus potanini* Golovatch, 1991, ♂ from Maanyao-Yeniutang Pass, Sichuan. 30 — habitus, lateral view; 31, 32 — anterior part of body, dorsal and ventral views, respectively; 33 — midbody segments, dorsal view; 34 — posterior part of body, dorsal view; 35 — both gonopods *in situ*, ventral view. Pictures by K.V. Makarov, taken not to scale.

Рис. 30–35. *Epanerchodus potanini* Golovatch, 1991, ♂ с перевала Maanyao-Yeniutang (Сычуань). 30 — общий вид, сбоку; 31, 32 — передняя часть тела, соответственно сверху и снизу; 33 — среднетуловищные сегменты, сверху; 34 — задняя часть тела, сверху; 35 — оба гонопода на месте, снизу. Фотографии К.В. Макарова, снято без масштаба.



Figs 36, 37. *Epanerchodus potanini* Golovatch, 1991, ♂ from Ershili, Sichuan. 36 — leg 9, lateral view; 37 — leg 7, lateral view. Pictures by K.V. Makarov, taken not to scale.

Рис. 36, 37. *Epanerchodus potanini* Golovatch, 1991, ♂ из Ershili (Сычуань). 36 — нога 9, сбоку; 37 — нога 7, сбоку. Фотографии К.В. Макарова, снято без масштаба.

DIAGNOSIS. In sharing, among numerous other characters, the head distinctly narrower than the collum, combined with a poorly developed tergal sculpture; a brown general colouration; a stout gonopodal telopodite lacking an exomere; a relatively short, simple and strong endomere (**en**) supplied with two processes at its base (**p1** and **p2**), *E. wolongensis* sp.n. seems to be especially similar to *E. liuae* sp.n. (see above) and *E. yunnanensis* (see Golovatch, 2014a]. However, it differs readily from both by the ventral setation of ♂ legs, the presence of laterally bulging ♂ femora, and the peculiar shapes of the clivus, endomere and process **p1** of the gonopods.

DESCRIPTION. Length of ♂♂ ca 15 mm, width of midbody pro- and metazonae 1.1 and 2.0 mm, respectively. Length of ♀♀ ca 16 or 20 mm, width of midbody pro- and metazonae 1.5–1.6 and 2.5–2.6 mm, respectively. Colouration in alcohol mostly rather uniformly light grey pinkish, more rarely brown with lighter paraterga and legs (Figs 13–17).

All characters as in *E. liuae* sp.n., except as follows.

Tegument shining. Antennae slightly shorter, and paraterga slightly less strongly developed and set lower, in ♀ than in ♂. In width, head < collum < segment 2 < 3 = 4 < 5=15(16), thereafter body gradually tapering towards telson (Fig. 13). Paraterga very strongly developed, mostly weakly upturned above dorsum. Metatergal sculpture typical, but usually slightly more strongly developed (Figs 13–17).

Legs generally rather long and slender, incrassate and slightly longer in ♂ compared to ♀ (Figs 15, 19), very densely setose, ventrally with bi- or trifid setae on prefemora, femora and most of postfemora, and with sphaerotrichomes on postfemora (only distally), tibiae and tarsi in ♂, only with simple setae in ♀; prefemora clearly bulged laterad only in ♂ (Fig. 19).

Gonopods (Figs 18, 20, 21) with prefemorite (= densely setose part) about 1/3 as long as entire telopodite; clivus (**c**) a large, lateral, subrectangular lobe; endomere (**en**) very strong and regularly curved, at apex narrowly subtruncate and subunciform, devoid of subapical filaments; a strong axe-shaped (**p1**) and a longer spiniform process (**p2**) at base of **en**.

REMARK. Using the latest available keys to *Epanerchodus* species of mainland China [Golovatch, 2014a; Liu, Golovatch, 2018], as well as the later described congeners [Liu, Huo, 2020] and the above *E. liuae* sp.n., like the latter species, *E. wolongensis* sp.n. invariably keys out to deadend couplets.

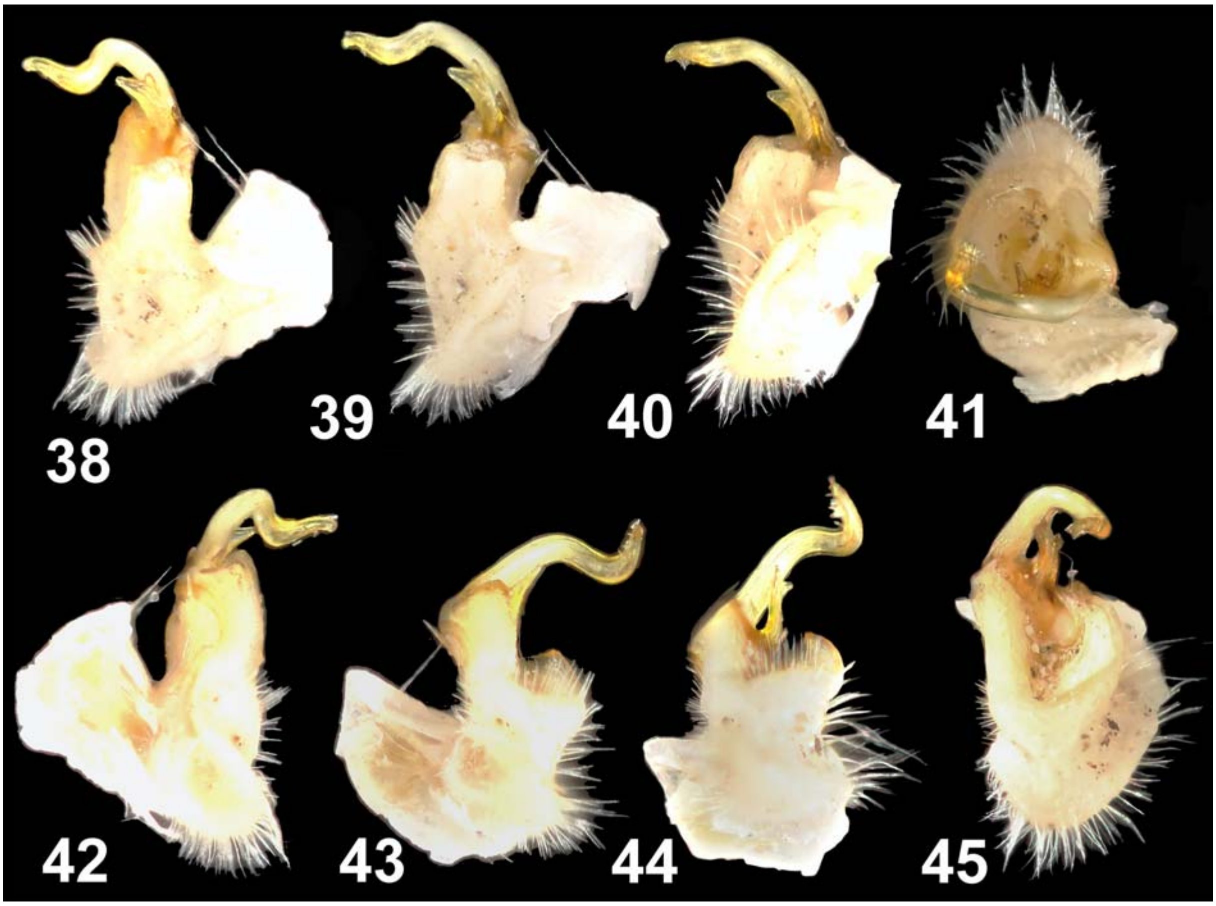
Epanerchodus martensi Golovatch, 2014

MATERIAL. 1 ♂, 1 ♀, 7 juv. (SMF), China, Shaanxi Prov., Taibai Shan Mts, S flanks, above Houshenzi, 1700 m a.s.l., primary broadleaved forest, 20.VII.1997, P. Jäger & J. Martens leg.

REMARK. The above samples represent strict topotypes of this species [Golovatch, 2014a].

Epanerchodus potanini Golovatch, 1991
Figs 22–45.

MATERIAL. 2 ♂♂ (ZMUM), China, Gansu Prov., NNE of Zhugqu, Minjiang Basin, 3 km ENE of Xiaohuangya, Qinyugou, N 33°50′08″, E 104°25′39″, 3045 m a.s.l., 4.VII.2017, I. Belousov & I. Kabak leg.; 1 ♂, 1 ♀, 1 subadult (ZMUM), China, Sichuan Prov., E of Maoxian-Songpan road, Maanyao-Yeniutang Pass, N 32°00′, E 103°45′24″, 3955 m a.s.l., 7.VII.2015; 1 ♂, 2 ♀♀ (ZMUM), China, Sichuan Prov., W of Maoxian, 8.3 km NW of Kekecun, N 31°41′44″, E 103°44′02″, 2630 m a.s.l., 7.VII.2015; 1 ♂, 1 ♀, 2 subadults (ZMUM), China, Sichuan Prov., N of Wenchuan, NE of Longxixian, Ershili, N 31°37’46″, E 103°36’39″, 2610 m a.s.l., 8.VII.2015; 1 ♂ (ZMUM), China, Sichuan Prov., N of Wenchuan, NE of Longxixian, 2.4 km NNE of Ershili, N 31°38′54″, E 103°37′29″, 3140 m a.s.l., 9.VII.2015, all I. Belousov, I. Kabak & G. Davidian leg.



Figs 38–45. *Epanerchodus potanini* Golovatch, 1991, ♂ from Ershili, Sichuan. Right gonopod, various views. Pictures by K.V. Makarov, taken not to scale.

Рис. 38–45. *Epanerchodus potanini* Golovatch, 1991, ♂ из Ershili (Сычуань). Правый гонопод, разные аспекты. Фотографии К.В. Макарова, снято без масштаба.

REMARKS. This common species is widespread in the mountains of Gansu and Sichuan provinces, marginally occurring in northwestern Yunnan as well [Golovatch, 1991, 2014a, b]. It seems to be typically high-montane, encountered between 2475 and 4035 m a.s.l. New illustrations are provided to document variations in habitus and colouration (Figs 22–35), as well as leg (Figs 36, 37) and gonopodal structure (Figs 38–45).

Acknowledgements. Special thanks are due to the collectors who rendered me their material for treatment: Igor Belousov, Ilya Kabak and Genrikh Davidian (all St. Petersburg, Russia), as well as Jochen Martens (Mainz, Germany) and Peter Jäger (SMF, Germany). Kirill V. Makarov (Moscow, Russia) very skillfully took and edited the colour pictures used in the present study. The author was partly supported by the Presidium of the Russian Academy of Sciences, Programme No. 41 "Biodiversity of Natural Systems and Biological Resources of Russia".

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